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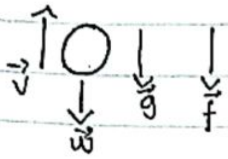

Berdasarkan Hk II Newton

$\Sigma \vec{F} = m\vec{a}$

$\vec{w} + \vec{F} = -m\vec{a}$

$(mg + bv)\hat{y} = -ma\hat{y}$

$(\cancel{m}g + bv) = -\cancel{m}\vec{a} \quad \left(\times \frac{1}{\cancel{m}}\right)$

$g + \frac{b}{m}v = -a$

Substitusi nilai a

$g + \frac{b}{m} v = -\frac{d^2 y(t)}{dt}$

$g + \frac{b}{m} v = \frac{-dv}{dt}$

$\frac{-dv}{g + \frac{b}{m} v} = dt$

$= \int_{v_0}^{v(t)} \frac{dv}{g + \frac{b}{m} v} = \int_0^t dt$

Misal $= g + \frac{b}{m} v = u$

$= \frac{b}{m} dv = du$

$du = \frac{m}{b} du$

maka

$\int_{v_0}^{v(t)} \frac{1}{u} dv = \int_0^t dt$

$= \int_{v_0}^{v(t)} \frac{1}{u} \left(\frac{m}{b} du\right) = \int_0^t dt$

$-\frac{m}{b} \ln |u| = t$

$-\frac{m}{b} \ln \left| g + \frac{b}{m} v \right|_{v_0}^{v(t)} = t$

$-\frac{m}{b} \left(\ln \left| g + \frac{b}{m} (v(t)) \right| - \ln \left| g + \frac{b}{m} (v_0) \right| \right)$

karena : $\ln a - \ln b = \ln \frac{a}{b}$, maka

$\ln \left| \frac{g + \frac{b}{m} (vt)}{g + \frac{b}{m} (v_0)} \right| = -\frac{bt}{m}$

$\exp\left(\ln \left| \frac{g + \frac{b}{m} v(t)}{g + \frac{b}{m} v_0} \right| \right) = e^{-\frac{bt}{m}}$

$\frac{g + \frac{b}{m} v(t)}{g + \frac{b}{m} v0} = e^{-\frac{bt}{m}}$

$g + \frac{b}{m} v(t) = \left(g + \frac{b}{m} v_0 \right) e^{-\frac{bt}{m}}$

$\frac{b}{m} v(t) = \left(g + \frac{b}{m} v_0 \right) e^{-\frac{bt}{m}} - g \left(\times -\frac{m}{b} \right)$

$v(t) = \frac{m}{b} \left(g + \frac{b}{m} v_0 \right) e^{-\frac{bt}{m}} - \frac{mg}{b}$

$v(t)^2 = \left(\frac{mg}{b} + v_0 \right) e^{-\frac{bt}{m}} - \frac{mg}{b}$

karena : $f = w$

$bv = mg$

$v_T = \frac{mg}{b}$ maka.

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$$v(t) = (v_T + v_0)\, e^{-\frac{bt}{m}} - v_T$$

untuk $a(t)$

$$a(t) = \frac{dv(t)}{dt}$$

$$a(t) = (v_T + v_0)\left(-\frac{b}{m}\right) e^{-\frac{bt}{m}}$$

$$= \frac{-b}{m}(v_T + v_0)\, e^{-\frac{bt}{m}}$$

$$= \left(-\frac{\cancel{b}}{\cancel{m}} \cdot \frac{\cancel{m}g}{\cancel{b}} - \frac{b}{m} v_0\right) e^{-\frac{bt}{m}}$$

$$a(t) = \left(-g - \frac{b}{m} v_0\right) e^{-\frac{bt}{m}}$$

untuk $y(t)$

$$v(t) = \frac{dy(t)}{dt}$$

$$dy(t) = v(t) \cdot dt$$

$$\int_0^{y(t)} dy(t) = \int_0^{t} v(t)\, dt$$

$$y(t) = \int_0^{t} \left((v_T + v_0)\, e^{-\frac{bt}{m}} - v_T\right)$$

$$y(t) = \left[(v_T + v_0)\left(\frac{-m}{b}\right) e^{-bt/m} - v_T \times t\right]_0^{x}$$

$$y(t) = \left[(v_T + v_0)\left(\frac{-m}{b}\right) e^{-bt/m} - v_T t\right] - \left[(v_T + v_0)\left(\frac{-m}{b}\right)\right]$$

$$y(t) = \frac{-m}{b}(v_T + v_0)\left(e^{-bt/m} - 1\right) - v_T \cdot t$$

$$y(t) = -\frac{m}{b}(v_T + v_0)\left(1 - e^{-bt/m}\right) - v_T \cdot t$$

Aproksimasi

$$e^{x} = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$$

$$e^{-\frac{bt}{m}} = 1 - \frac{bt}{m} + \frac{1}{2}\left(\frac{bt}{m}\right)^2 + \dots$$

$$y(t) = -v_T + \frac{m}{b}(v_T + v_0)\left(1 - e^{-bt/m}\right)$$

$$= -v_T t + \frac{m}{b}(v_T + v_0)\left(1 - 1 + \frac{bt}{m} - \frac{1}{2}\left(\frac{bt}{m}\right)^2\right)$$

$$= v_0 t = \frac{1}{2} g t^2 - \frac{1}{2}\frac{b}{m} v_0 t^2$$

$$y(t) = v_0 t - \frac{1}{2} g t^2 - \frac{1}{2}\frac{b}{m} v_0 t^2$$

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untuk $b=0$ maka,

$$y(t) = v_0 t - \frac{1}{2} g t^2$$

$v(t)$

$$v(t) = (v_T + v_0)\, e^{-bt/m} - v_T$$

$$= -v_T + (v_T + v_0)\,(1 - bt/m)$$

$$= -\cancel{v_T} + \cancel{v_T} \frac{-b}{m} v_T\, t + v_0 \frac{-b}{m} v_0 . t$$

$$= v_0 - \frac{\cancel{b}}{\cancel{m}}\left(\frac{\cancel{m}g}{\cancel{b}}\right) t - \frac{b}{m} v_0 t$$

$$v(t) = v_0 - gt - \frac{b}{m} v_0 t$$

untuk $b=0$ maka,

$$v(t) = v_0 - gt$$

$$a(t) = (-g - b/m\, v_0)\, e^{-bt/m}$$

$$= (-g - b/m\, v_0)\,(1 - bt/m)$$

$$= -g + \frac{g\,bt}{m} - \frac{b}{m} v_0 + \frac{b^2}{m^2} v_0 t$$

$$a(t) = -g - \frac{b}{m} v_0 + \left(\frac{b^2}{m^2} v_0 + \frac{gb}{m}\right)$$

maka $b=0$

$$a(t) = -g$$

Dipindai dengan CamScanner